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Learning about knowledge management for improving environmental impact assessment in a government agency: The Western Australian experience

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Abstract

How does knowledge management (KM) by a government agency responsible for environmental impact assessment (EIA) potentially contribute to better environmental assessment and management practice? Staff members at government agencies in charge of the EIA process are knowledge workers who perform judgement-oriented tasks highly reliant on individual expertise, but also grounded on the agency's knowledge accumulated over the years. Part of an agency's knowledge can be codified and stored in an organizational memory, but is subject to decay or loss if not properly managed.

The EIA agency operating in Western Australia was used as a case study. Its KM initiatives were reviewed, knowledge repositories were identified and staff surveyed to gauge the utilisation and effectiveness of such repositories in enabling them to perform EIA tasks.

Key elements of KM are the preparation of substantive guidance and spatial information management. It was found that treatment of cumulative impacts on the environment is very limited and information derived from project follow-up is not properly captured and stored, thus not used to create new knowledge and to improve practice and effectiveness. Other opportunities for improving organizational learning include the use of after-action reviews. The learning about knowledge management in EIA practice gained from Western Australian experience should be of value to agencies worldwide seeking to understand where best to direct their resources for their own knowledge repositories and environmental management practice.

Key-words: environmental impact assessment, knowledge management, organizational learning, decision-making, environmental agencies.

Abbreviations:

DEC – Department of Environment and Conservation (Western Australia)
EIA – Environmental Impact Assessment

EIS – Environmental Impact Study or Statement

EPA – Environmental Protection Authority (Western Australia)

EPAct – Environmental Protection Act 1986 (Western Australia)

GIS – Geographical Information System

KM – Knowledge management

NGO – Nongovernmental Organization

OEPA – Office of the Environmental Protection Authority (Western Australia)

US – United States

WA - Western Australia

1. Introduction

Environmental impact assessment (EIA) is a legal requirement in most countries worldwide for the appraisal of development projects that can significantly affect the environment. It is an important tool for managing human uses of the environment through a systematic and public process for identifying and designing environmentally sustainable development projects, plans and programs. Wherever practiced, the EIA process is implemented and managed by one or more government agency. Each year, dozens, hundreds or even thousands of EIAs may be carried out in a particular jurisdiction.

Our interest is in how the responsible government agencies (hereafter EIA agency) manage the considerable volume of knowledge generated through EIA and how it is used to improve future EIA and environmental management practice. Knowledge management (KM) aims at stimulating and enhancing collective organizational skills and competencies (Standards Australia, 2005). Studies of KM and organisational learning by private and government organisations are well documented in the international literature but to date relatively little pertains specifically to EIA agencies.

Key roles of EIA agencies include managing the EIA process in a particular jurisdiction, including enforcement of legal requirements for assessing proposals and designing and implementing a series of procedures to guide operations. They perform the crucial task of quality control by reviewing EIA documents, in particular the environmental impact study or statement (EIS) prepared by the proponent of the activity being assessed. In

performing their work, EIA agencies can (i) accumulate information and knowledge; (ii) learn from experience; and (iii) establish new procedures or policies aimed at improving EIA efficiency or effectiveness. Thus EIA agencies can be framed as learning organisations (Argyris and Schön, 1996).

Our focus is where there is a centralised EIA agency responsible for managing the process and for carrying out all or most EIA tasks. This model is used in countries such as Australia, Brazil and Mexico, where an environmental agency or Ministry has statutory power to approve, refuse or to impose conditions on actions that can significantly harm the environment. An alternative approach based on having a responsible competent decision-making authority for each development sector which must observe EIA requirements and demonstrate that they have been fulfilled when delivering the appropriate permits (as used in most of the European Union) is not addressed here.

A central EIA agency can facilitate the appraisal of the real outcomes of EIA in one particular jurisdiction, as well as provide essential data for evaluating process effectiveness. In his comparative review of EIA in selected countries Wood (2003, p. 312) noted that: 'it is probably no coincidence that the EIA systems which are monitored all possess a single body with overall responsibilities for EIA'. Thus KM by centralized agencies offers huge potential for organizational learning (OL) for EIA enhancement, as they deal with a larger variety and number of proposals than competent authorities. Experience gained can be useful for future assessments, i.e. EIA can be seen as a learning process (Saarikoski, 2000; Sadler, 1996, p. iii).

Our interest concerns management of knowledge by EIA agencies to facilitate this learning process. Specifically our research had the following aims:

- identify and evaluate knowledge repositories established by a centralised EIA agency to understand both how they evolved and how they are used to improve ongoing EIA; and
- derive possible lessons that could be applied to or adapted by similar agencies in other jurisdictions.

We selected the Office of the Environmental Protection Authority (OEPA) of Western Australia (WA) as the centralised EIA agency case study for this research. There has been a long tradition of reporting on innovations in EIA practice in WA which demonstrate elements of organisational learning directed at improving processes (e.g. Hollick, 1981; Bailey and Saunders, 1988; Glasson, 1999; Middle and Middle 2010). When comparing EIA systems in different countries, Wood (1999) concluded that: 'Widely perceived as a comprehensive and effective EIA system, Western Australia's EIA process is of particularly comparative interest'. Thus, by analyzing the KM approach of the OEPA, there is a potential to derive lessons for international practice in EIA. As EIA is a universal tool, lessons drawn from one jurisdiction may be relevant to improve practice elsewhere (Wood, 1994).

In large part our research was guided by interviews with senior staff from the OEPA and key results based on a survey of all staff who make use of the OEPA's knowledge repositories in their work. Before presenting details of the survey methodology and

results, we summarise the principles of KM and organisational learning based on key findings from the international literature. We then relate this to the role of EIA agencies and the potential of KM to influence ongoing and future EIA practice. This background provided a foundation for our detailed investigation of the KM initiatives utilised by the OEPA in Western Australia. In order to contextualize our findings, we provide an overview of the EIA arrangements in the State. Following presentation of our methodology and results, we conclude with a discussion of the implications of our findings with respect to foreseeable improvements in Western Australian practice as well as possible implications for international EIA practice.

2. Knowledge management perspectives

The need for knowledge management in the public administration and the formulation of public policies received early recognition by authors such as Henry (1974), in the face of the then emerging information technologies and the rise of "information-based governmental agencies", such as, in the United States, the Environmental Protection Agency and the President's Council on Environmental Quality together with the 'extremely far-reaching National Environmental Policy Act' (p. 190), the law approved by the US Congress in 1969 which first institutionalized EIA, a policy tool later adopted worldwide.

Today, KM is an acknowledged facet of organizational development and management. Possible advantages of KM include: (i) reducing the costs of repeatedly developing solutions (Szulanski, 1996); (ii) identifying and replicating best practices (Olivera,

2000); (iii) buffering an organization from the disruptive effect of staff turnover (Argote et al., 1990). The notion of organizational learning (Argote, 1999; Argyris and Schön, 1996), formulated in the 1970s, tries to explain why and how knowledge can be used to achieve an organization's goals.

Approaches to KM discussed in the international literature broadly revolve around systems for identification, creation, storage, retention, use, sharing and transfer of knowledge (e.g. Davenport and Prusak, 1998; Argote et al. 2003; European Standard CWA 14924: 2004; Rashman et al., 2009) and are applicable to private and public organizations alike. In short, KM systems comprise the set of dispersed knowledge (held by individuals and stored in documents) and the mechanisms to make that knowledge accessible; which Olivera (2000, p. 813) refers to as organisational memory.

The location of organizational memory is multiple and includes individual staff, technical systems (e.g. electronic databases) and paper records, organizational routines and procedures, as well as social networks and the routines and values of the organizational culture (Argote, 1999; Nakano and Fleury 2005; Pollitti, 2009). Thus two broad approaches are generally recognized as necessary to enable implementation of KM strategies: technology-based (such as databases, intranet) and human resources or the knowledge that resides within individuals. As noted by Handzic (2005) information technology has become essential for: (i) building knowledge repositories, (ii) facilitating knowledge searching and discovery, and (iii) promoting socialization and collaboration, so that apart from the personal knowledge of staff it is virtually impossible to implement KM initiatives without technological support. An organisation cannot solely

rely on the knowledge embedded in individuals, as ‘the contents of social networks are subject to decay as a consequence of turnover’ (Argote, 1999).

The importance of memory for organizations is widely recognized. Functions of organizational memory include: (i) support to problem-solving; (ii) support to decision-making and (iii) maintenance of routine behaviours, norms and shared interpretations (Olivera, 2000). Walsh and Ungson (1991) remark that decisions are likely to be more effective when considered in terms of organization’s history than when made in a historical vacuum. Thus retention of an organisation's knowledge is vital; Argote et al (2003, p. 572) define this as ‘embedding knowledge in a repository so that it exhibits some persistence over time’. Pollitt (2009) warns about the risks of memory loss, Othman and Hashim (2004) of organizational amnesia and Argote (1999) of organizational forgetting.

Other desirable features of knowledge repositories beyond the issue of retention include their accessibility and availability, relevance and specificity of contents, effectiveness of indexing (easiness to find contents), frequency and importance of use, response time and the extent to which the knowledge content has been filtered and is updated (Olivera 2000, p. 826; Cheung et al. 2007, p. 151).

Although a broader review of organizational learning is not possible here, it is convenient, for the purposes of this paper, to note two central concepts: (i) a distinction should be made between organization learning and adaptation, as change does not necessarily imply learning (Fiol and Lyles, 1985); (ii) the distinction, made by

Argyris and Schön (1996), between single- and double-loop learning, which is often used to explain learning in organizations; single loop learning is understood as that which modifies strategies of action as a result of perceived mismatch of outcomes to expectations; double loop learning arises from questioning the values and norms that guide action and can lead to deeper and higher level changes.

So far our discussion of KM has largely been drawn from the managerial literature. Studies about knowledge management and learning by organizations involved in the EIA process are scarce. There have been a number of studies focussing on learning and change by EIA agencies, but these have principally documented examples of collaborative social learning arising from the public participation component of EIA exerting external influence on agency knowledge, behaviour and operations. Pioneering studies by Hill and Ortolano (1976) and Brendecke and Ortolano (1981) based on interviews with 350 staff from two government agencies involved in the EIA process in the US found evidence that external input did influence decision-making in those agencies, which then reflected information generated as a result of the interagency and public review of draft environmental impact statements (EISs). More recent examples can be found in Webler at el., 1995; Saarikoski 2000; Chávez and Bernal, 2008; Sánchez-Triana and Ortolano, 2001; Sinclair et al., 2008) while social learning in the context of natural resource management is also receiving growing attention in the literature (e.g. a review by Blackmore, 2007).

A more explicit focus on internal learning by EIA agencies with a KM related element is evident in Fitzpatrick (2006) who explored organizational learning associated with

the EIA process in the case of two projects (a dam and a mine) submitted to different Canadian jurisdictions, which involved 41 organizations, both governmental and non governmental. She found that 'all organizations' (p. 177) experienced learning outcomes. Government actors emphasized single-loop learning, or activities designed to improve performance within the existing process; on the other hand, non government actors, identified a wider range of outcomes centred on changing process that can contribute to future assessments, i.e. double-loop learning. Four government organizations directly involved in the cases reviewed by Fitzpatrick (2006) used formal 'post hoc reviews' of the environmental assessment activities as a mechanism to derive lessons learned. Knowledge repositories used by these government organizations included assessment reports (a publicly available document summarizing the assessment findings and recommendations) and reports of post hoc studies and records of assessment activities (files containing documents pertaining to the EIA process).

It is clear from the literature that knowledge management and organisational learning by government agencies makes an important contribution to the achievement of their functions. In this research we set out to document how KM initiatives by a leading EIA agency have contributed to improvements in environmental protection and management.

3. Objectives and methods

The research sought to identify key elements of KM undertaken by the OEPA for improving EIA practice, especially with regard to the responsibilities of that agency, and then determine to what extent KM initiatives could contribute to enhance EIA

effectiveness in Western Australia more generally. By adopting a case study approach (i.e. with OEPA as the case study unit) we wished to derive possible lessons that could be applied to or adapted by similar agencies in other jurisdictions. As Yin (2003) points out, case study research allows for making inferences and reaching valid conclusions that can be generalized to theoretical propositions (p.10), as well as developing propositions for further enquiry (p. 6).

The data collection methods were document review, participant observations, interviews and questionnaires. Document review included a thorough search of the OEPA website (i.e. the principal public interface of the agency: www.epa.wa.gov.au/) and the selective review of key present and past documents. One of the authors has been analyzing EIA practice in Western Australia for a number of years and has recently participated in a number of ad hoc committees responsible for reviewing EIA procedures and practice in this jurisdiction; some insights arose from these committee meetings. Open semi-structured interviews were conducted with four senior OEPA staff members (including the current and one past Director) as well as one of the technical staff. Finally, a questionnaire was applied to OEPA staff.

The purposes of document review, participant observations and interviews were:

- to identify milestones of EIA in Western Australia that could reflect improvements resulting from “learning from experience”;
- to identify the knowledge repositories currently used at OEPA;
- to capture how they evolved and how they relate to EIA practice; and
- to identify currently perceived gaps and foreseen improvements.

This combination of data collection approaches enabled important internal OEPA tasks and operations to be identified with respect to how EIA is carried out internally.

The interviews were conducted with 7-10 days intervals between them, thus allowing time for gaining some familiarity with documents or events mentioned by the interviewees and to consider the appropriateness of modifying the questions to be formulated to the next interviewee. The interviews were carried out in an evolving and opportunistic, although structured, manner designed to maximise researcher understanding and depth of knowledge, as opposed to posing an identical suite of questions to a range of interviewees; such approaches being common in qualitative social science research (e.g. Neuman, 2000). A key outcome of the interview sequence was fine-tuning of the questionnaire for OEPA staff, a draft version of which had been prepared on the basis of document reviews and participant observations. Prior to questionnaire application, two pilot tests were conducted with senior staff members who were asked to carefully scrutinize the wording used in each question, in order to minimize ambiguities.

The final version of the questionnaire was distributed to the 40 potential respondents (i.e. OEPA project officers and their branch managers) following an oral presentation addressing the research purposes and the objectives of the questionnaire; this was scheduled to take place at a relatively informal weekly staff meeting to which external speakers are occasionally invited. Purposes of the questionnaire were:

- to collect evidence of knowledge management actual practices; and

- to survey how the organization's knowledge repositories are perceived in terms of effectiveness and usefulness to internal users.

The questionnaire was structured around the following topics: (1) sources and repositories, (2) usefulness and access, (3) knowledge creation and learning environment, (4) identifying gaps and improvements and (5) context (respondent contextual data about professional experience within OEPA). Respondents remained anonymous. The questionnaire was designed having in mind its possible application to other EIA agencies, thus enabling comparative studies. The questionnaire is at one time part of the research method and a product of the research, as it was tailor-made to reflect surveyed knowledge repositories operated by the OEPA.

Insights for designing the questionnaire were gained from several sources, in particular: CEN (2004), Cheung et al. (2007), Olivera (2000), Standards Australia (2005). A number of questions were formulated using a Likert scale, where an item is presented as a declarative sentence, followed by response options that indicate varying degrees of agreement with or endorsement of the statement (DeVellis, 1991, p. 68). Questions on access to knowledge repositories and their usefulness for performing EIA tasks were formulated using a four-level scale indicating frequency of access. Two open questions sought the respondents' opinion about gaps in the current repositories and opportunities for improvement.

Three weeks were allowed for reply and a total of eighteen questionnaires were returned. Given that a number of potential respondents were on extended leave over the

whole period allowed for reply, this represented a roughly 50% return rate. Answers were organized in tables and analyzed descriptively by grouping frequencies.

Before presenting the results obtained it is useful to set the scene for our analysis by outlining the context in which the OEPA operates.

4. The EIA process in Western Australia and its management

The state of Western Australia has had EIA processes in operation since 1974. Since then there have been progressive modifications to the guiding legislation, supporting administrative procedures and other comprehensive guidance, in response to growing maturity in practice and especially the move towards more strategic approaches to EIA. Legal responsibility for the EIA process rests with the Environmental Protection Authority (EPA) in accordance with the provisions of the *Environmental Protection Act* 1986 (WA) (hereafter EPAct). While the EPAct specifies some of the procedures for EIA, including responsibilities and functions of the EPA and of the Minister for the Environment and appeal processes, separate Administrative Procedures, prepared by the EPA in accordance with the EPAct and published in the Government Gazette in 2002, outline the objectives of and procedures for EIA in the State.

The EPA is a statutorily independent panel of five people that provides advice to the Environment Minister on environmental matters including all proposals subject to EIA. Four of the EPA members undertake this role on a part-time basis and the panel meets on one day each fortnight. While the EPA is the legal entity responsible for undertaking

EIA (e.g. author of all EIA guidance documents and reports to Minister) the day to day EIA work is carried out by (full-time) public servant staff within the OEPA on behalf of the panel; hence, it is the workings of the OEPA that is our focus in this research. More specifically it is the project officers and branch managers who actually perform the key EIA tasks and who are main users of knowledge repositories and organizational memory within OEPA.

While the EIA component of the EPAct is administered by the OEPA, other aspects of environmental management (e.g. natural areas management, licensing and pollution control) covered by the Act are the responsibility of the Department of Environment and Conservation (DEC). As might be expected, there is some inter-relationship between the activities of DEC and those of the OEPA (e.g. environmental expertise within DEC is often utilised as an input to individual assessments). For the remainder of this paper our focus is exclusively on the EIA-related activities within the OEPA.

Figure 1 shows the current EIA process in WA, the local terms for the main steps of the process and the main input and output documents. The “steps of the EIA process” column depicts in bold types the terminology usually employed internationally or in textbooks. It can be observed that the WA process comprises all the major steps, including scoping and follow-up, which are absent in a number of EIA systems (Bond and Wathern, 1999). The figure also depicts the main tasks performed by OEPA officers in order to comply with legal requirements and internal procedures. The “internal procedures” and "outputs" columns indicate the main tasks and are expressed in the local terminology.

Figure 1

Five levels of environmental assessment were in use in WA at the time of research. The term "referral" means the submission of information about a proposal (project or land use plan) for screening, i.e. decision on the need to assess and the level of assessment required. The main types of EIS are known as Public Environmental Report (PER) and the Environmental Review and Management Programme (ERMP). Unlike other jurisdictions, public hearings are not part of the process. Public consultation is formally provided for via public announcements of new proposals and by a period of public comment when written submissions are received by the OEPA. However, project proponents are expected to consult with the public and relevant government agencies as part of project planning and clear evidence of consultation activities must be given alongside the environmental impact study. There are also a number of third party appeal rights for several steps in the process.

An indicator of the volume of the staff workload is provided by the numbers of proposals received and assessments performed, available from the EPA annual reports. Between 1998-2009, OEPA performed on average 535 reviews of development proposals and planning schemes each year, out of which formal assessments were required for 46 proposals (or 8.6% of total referrals). For those proposals not subject to formal assessments, specific advice to decision-making authorities was provided on average to 227 proposals (42% of total referrals). In each year, the number of formal assessments actually completed averaged 39. Figure 2 shows the yearly number of main

documents received and processed by EPA in the period. In addition to these documents, staff also review changes to approved proposals requests, whose figures are not provided by the EPA annual reports.

Figure 2

The most common types of projects for which a full assessment has been required are mining, oil and gas development, and harbour and railway infrastructure, often associated with major resource development projects. Referrals, however, bring a range of proposals, including local zoning schemes, water supply projects, road construction and improvements. Screening does not utilise lists of types of proposals, as in many jurisdictions, but is determined on a case-by-case basis with respect to the likelihood that a proposal would have a significant effect on the environment.

5. Results and Findings

5.1 OEPA staff profile

The main users of knowledge repositories and organizational memory are project officers and branch managers who actually perform the tasks featured in Figure 1. In 2009, OEPA staff was composed of 37 project officers, three branch managers, two assistant directors and one director, totalling 43 technical staff directly involved in the core tasks. In addition, the OEPA is staffed with five administrative officers and five specialists in geographical information systems.

The OEPA staff come from a range of backgrounds and professional experience. As of October 2009, 30% of the staff had been working at OEPA for less than two years, 17% between two and five years, 25% between five and ten years and 28% for more than ten years. Staff turnover was seen as a problem in the period 2002-2008, coinciding with an economic boom in the State due to a thriving natural resource sector, especially mining and gas. In that period, about 20% of the staff left every year, obliging the organization to hire new graduates and to provide on-the-job training.

5.2 Mapping knowledge repositories

The knowledge repositories utilised by the OEPA staff in carrying out their EIA duties are summarised in Table 1. Some are available only for internal use, such as the geographical information system (GIS) and the Officers Manual, but most are publicly accessible items. Table 2 provides a summary explanation of the contents of each type of repository. Inevitably, overlapping exists. Some repositories were prepared for the benefit of the OEPA's clients, i.e. project proponents, decision-making authorities, environmental consultants and the public. These documents aim at clarifying EPA understanding on a particular subject or to provide specific guidance on contents of documents to be presented or methods for collecting or analyzing environmental information. Other repositories are primarily intended for internal use, as they set out internal procedures.

Table 1

443 Table 2

444

445 **5.3 Initiatives related to knowledge management and organizational learning**

446

447 Notwithstanding that OEPA has not implemented any formal KM program, several
448 internal management initiatives relevant as enablers[i] of organizational learning have
449 been developed over time: (1) quality assurance, (2) spatial information management,
450 (3) records management, (4) mentoring, (5) training, (6) preparing and publishing
451 guidance, and (7) the "back-catalogue" or library archive of all EPA documents from
452 1974 onwards. These are briefly described followed by one further initiative that
453 commenced during our research.

454

455 A quality assurance program for EIA started in the mid-1990s leading to improved
456 efficiency through elimination of 'unnecessary steps and duplication' and possibly
457 enhancing effectiveness by means of a 'more systematic methodology' for
458 environmental acceptability criteria.[ii] An internal manual was issued, containing, among
459 other elements, detailed procedures for EIA tasks, a template for internal procedures, a
460 document control protocol, and standardization of terminology.

461

462 The building of a GIS started in the late 1980s as part of a WA government-wide
463 initiative. Initially, the OEPA staff used spatial information essentially to check
464 presence or absence of environmental values when a proposal was received. Published
465 EPA guidance provides a series of specific requirements about a range of
466 "environmental values", also known in the EIA literature as "valued ecosystem

components". Western Australia examples of such environmental values include "declared rare flora" and "threatened ecological communities".

Currently, OEPA has a dedicated GIS group staffed by five specialists who not only maintain and update information on environmental values but also perform a "proximity analysis" for every proposal referred to the EPA. Such an analysis means producing a map featuring the new proposal, former proposals and environmental values at distances of 200 m, 500 m and 2 km from the proposed development, thus providing project officers with a quick overview of the spatial context of matters that might represent a significant effect on the environment associated with the proposal. The group also systematically captures the boundaries of all proposals referred to EPA in a spatial dataset.

OEPA has adopted a records management system to ensure file and document tracking, as well as a database of ongoing and past assessments including proponent details, decisions made and timelines. Both systems are on the OEPA's internal Intranet and subject to improvements and upgrades. However, the organization also maintains files containing a hard copy of all relevant documents for every assessment which are updated and consulted by project officers.

The effects of staff turnover are dealt with by adopting an array of measures. New staff are informed by several ways. There is a half-day introductory course, an active mentoring program and ad hoc provision of short-courses. All new staff have an experienced staff member assigned as mentor, who, like in traditional apprenticeship,

491 ‘impart their tacit knowledge, as well as demonstrate their skill and exemplar
492 behaviours’ (Agimo, 2004, p. 9).
493
494 Since 2006, the OEPA in partnership with the Environmental Consultants Association
495 (WA) Inc. has provided bi-annual offerings of a two-day residential training course
496 entitled “Environmental Assessment for Practitioners”, especially targeted towards
497 environmental consultants and newer staff members within the OEPA. A vital aspect of
498 each course offering has been the attendance of at least one senior OEPA member of
499 staff who can answer specific and detailed questions regarding procedures within the
500 unit. The training course is perceived as being valuable in developing professional
501 relationships between EIA practitioners in WA (Morrison-Saunders and Bailey, 2009).
502
503 Publishing guidance intended for stakeholders has been used by the EPA since the State
504 EIA system was formalized. These documents are available to OEPA staff and external
505 EIA practitioners alike. Between 1999 and 2006, nine EPA *Position Statements* were
506 produced; these provide the overarching principles and information which the EPA
507 would use when giving advice to the Minister, the public, proponents and decision-
508 makers to clarify their responsibilities for managing a particular environmental matter.
509 Between 1998 and 2009, four draft and 25 final EPA *Guidance Statements* were
510 produced; these provide the EPA's understanding about a particular issue against which
511 proponents can develop their proposals.[iii] Guidance documents have been updated or
512 expanded on several occasions, typically following amendment to the legislation. More
513 importantly, a new kind of guidance started being published in the late 1990s focusing
514 on recommendations for consultants and proponents to undertake their EIA tasks.

Guidance has been issued on numerous aspects of EIA practice, such as conducting terrestrial flora surveys, designing environmental offsets for proposals that impact on biodiversity, sampling of short range endemic invertebrates, criteria for protection of benthic habitat. We call this type of guidance “substantive”, as it is essentially different from procedural guidance intended at explaining details of a particular EIA system, such as “how to make submissions” or how many days an EIS is available for public comment.

One strong point of the EPA's approach to EIA is the formal publication of its recommendations to the Minister for the Environment for each individual assessment carried out. This series known as the EPA Reports extend from the first published in March 1974 to the present day (currently numbering more than 1300). These reports, systematically available via the Internet since 1989, document the history of EPA advice, recommendations and policies. The EPA has always hosted a publicly accessible library containing hard copy of the entire suite of EPA Reports (and other EIA documentation). While the EPA Reports are readily accessible, EIS and other environmental review documents are not held in any central repository and typically do not remain available on the Internet after the public review period closes; such documents must be obtained from the proponent’s website and are usually available only for a limited period. Hard copies may be available in the EPA's library, but the collection is incomplete.

Coincidently with the timing of the research, in May 2009, the Minister for the Environment established a “Shared Environmental Assessment Knowledge” (SEAK)

Taskforce comprising proponent, consultant, NGO and government agency representatives and chaired by the EPA Chairman. The purpose of the taskforce is to develop a shared environmental knowledge system for collecting, reporting and accessing environmental information and knowledge generated through the environmental assessment process (EPA 2009a, p. 51). More specifically the taskforce has been examining the creation, collection, organisation, storage, analysis, governance and communication of digital environmental knowledge in WA. The taskforce will make recommendations on a model for delivering improved environmental data management and knowledge building that enhances assessment and approvals processes. Their recommendations, however, were not publicly available at the time this paper was concluded.

5.4 Use of knowledge stored in organizational memory

Findings related to access and use of collective knowledge for performing the EIA tasks at the OEPA were obtained from the questionnaire. Out of 16 knowledge repositories (Table 1), respondents most often access previous EPA reports and the organization's hard files, alongside the sources which provide personal interaction (i.e. repositories 14 to 16). The least accessed sources are the GIS Viewer and the State of the Environment Report. It appears that sources that feature real cases or solutions are used most often relative to those that provide generic guidance. No additional internal knowledge source was mentioned, although space was provided in the questionnaire. A few external knowledge repositories were however identified, with non specified Internet sites most often mentioned, followed by scientific literature and external professional networks.

563

564 The five main EIA tasks (from Figure 1) of OEPA staff - (1) recommending the level of
565 assessment; (2) reviewing scoping documents; (3) reviewing the draft environmental
566 impact document; (4) preparing the draft EPA report and (5) preparing an appeal report
567 - were listed and survey respondents were directed to indicate ease of access to
568 knowledge repositories for performing those tasks. Several staff reported that tasks (3)
569 and (2) require slightly more frequent access to the repositories, but no significant
570 difference appeared, suggesting that no particular EIA tasks is viewed as more complex
571 than others by OEPA staff.

572

573 **5.5 Usefulness and accessibility of knowledge stored in organizational memory**

574

575 Nine statements related to usefulness and accessibility of knowledge repositories
576 derived from internal tasks and operations within OEPA were included in the
577 questionnaire (Table 3). Respondents were asked to declare their agreement with these
578 statements using a five level scale. The results show that:

579 - There is an ample agreement (72%) that Guidance Statements usefully condense
580 the organization's knowledge for use in EIA.
581 - There was some disagreement on the level of detail provided by Guidance
582 Statements, probably due to some being outdated, as noted by a few respondents,
583 and to some being detailed whereas others provide only general guidance.
584 - Most respondents disagreed with the statements that they may prefer to obtain
585 information from other people rather than from documents; this may suggest that
586 the initiative of writing guidance and making it available to staff is welcome. It

may also possibly reflect a preference by OEPA staff for being able to "defend" or be accountable for knowledge and views put forward in EPA documents; i.e. having a published source by way of back up. When these results were viewed in light of the number of years of employment within the OEPA (i.e. the respective groups of staff with less than 2 years in OEPA (n=8) and those with more than 10 years (n=6) of service) it was found that the less experienced staff were more likely to rely on documents rather than people and vice versa for the more experienced staff.

- All staff respondents indicated that they consult with people in the DEC, which is consistent with the notion of EIA as a multidisciplinary and multi-institutional activity.
- The level of disagreement with the statement that issues addressed by OEPA staff are typically so specific such that internal knowledge sources are not useful (72%) reinforces the finding that knowledge repositories are perceived as useful by staff.

Table 3

Respondents were also asked to rank the effectiveness of each knowledge repository in providing access to the organization's stored knowledge. A notion of effectiveness was advanced for the respondents as "the ease of access – in terms of time and effort – to OEPA collective experience and knowledge". Ranking utilised a five-level Likert scale. Fourteen out of the sixteen repositories were ranked as effective or very effective, with

only two ranked as ineffective or not used (GIS Viewer and the State of the Environment Report).

The low ranking obtained by GIS Viewer is explained by the fact that it is the interface available to project officers, while spatial data analysis is performed exclusively by GIS specialized staff. The results of the 'proximity analysis' are printed and included within a folder containing other project-related information. If a project officer needs more spatial information than is usually provided, he or she asks for assistance from the GIS team. This explains why GIS is an important tool, but the Viewer interface is not considered as an effective source by project officers.

The answers are consistent with those provided for the first question. Senior staff is the source that returned the most "very effective" ratings (65%). The sources that hit the higher percentages of "very effective" or "effective" combined were the EPA Reports and the internal meetings (both at 100%), followed by senior staff (94%) and the Officers Manual and templates (89%).

The reasons advanced for rating a source as effective or very effective are the ability to find information and possibility of obtaining insights to perform the tasks (89%). This explains why State of the Environment Reporting was considered to be ineffective; its scale of focus covering the entire land and coastal environment of Western Australia is too broad for application to specific projects. It is clear that the utility of the information obtained (i.e. meeting needs, enabling task performance and finding examples or

solutions) are the predominant benefits to nearly all respondents. Less than half of the respondents indicated speed of access as a reason for ratings of effectiveness.

The reason most cited for rating a source as ineffective or very ineffective is that "the information that can be found is outdated" (61% of respondents), whereas the response that "it is very time consuming to retrieve information from those sources" was cited by 50% of respondents. A number of reasons associated with information technology were also advanced.

Answers to open questions (i.e. a space in the questionnaire provided for free answers) included in the questionnaire frequently mentioned the need to update knowledge sources and to upgrade technology-based systems. In particular it appears that although the usefulness of the GIS is acknowledged, users feel the need to introduce improvements in terms of (i) compatibility with other government spatial information systems, especially DEC's and (ii) accuracy of information.

5.6 Knowledge creation

The research intended to capture staff perceptions about creating knowledge in their work. Six statements were provided and the respondents asked to rate their agreement (Table 4). Taken collectively, responses to each statement are overwhelmingly positive. This suggests that OEPA staff are proud of what they do and are generally positive about the experience both personally and in terms of what they achieve. When these results were viewed in light of the number of years of employment within the OEPA

(i.e. the respective groups of staff with less than 2 years in OEPA (n=8) and those with more than 10 years (n=6) of service) it was found that less experienced staff are:

- more enthusiastic about personal learning [statement A] and a belief in the value of well-informed EPA reports protecting the environment for present and future generations [statement F];
- not so sure that mistakes can/should be viewed as learning opportunities [statement C] or that new knowledge can be used in the future [statement D]; and
- more frequently negative about their personal contribution to providing new information that will be used in the future [statement E] relative to the more experienced OEPA staff members.

Table 4

6. Discussion

For the analysis intended in this paper, OEPA is viewed as an organization that processes information and delivers analysis in the form of advice and recommendations to the Minister for the Environment, to other decision-making authorities and to proponents. Information is supported by input documents provided by external organizations and concentrated in output documents (both depicted in Figure 1). Here we discuss the research findings under two perspectives: (1) the usefulness and effectiveness of knowledge repositories and (2) the array of KM initiatives employed

(or not) by the OEPA. The section closes with a discussion of knowledge issues not currently dealt with by the OEPA.

6.1 Coverage, usefulness and access to knowledge repositories

The 'capture and dissemination of socially constructed knowledge' is one particular aspect of KM in the public sector (Riege and Lindsay, 2006, p. 27). Undoubtedly the OEPA has been fulfilling this task and contributing to capturing and disseminating relevant knowledge for decision-making in Western Australia from 1974 onwards.

Knowledge contained in the repositories, in particular Guidance Statements, has been filtered by the organization, i.e. their content has been selected by groups of people in the organization and validated through consultation with staff within the OEPA, other government departments and different stakeholders. Hence, there is a profound difference between this kind of repository maintained by a government organization and private companies' knowledge repositories. Another characteristic of such public repositories is that individuals cannot make direct contributions to them, in contrast with some kinds of repositories used by private companies such as consultancies (Olivera, 2000).

The finding that OEPA staff prefer obtaining information from documents over other people corresponds with the findings of Morrison-Saunders and Bailey (2009) in a study of EIA consultants (especially) and also OEPA staff previously. They reported that inexperienced staff were more likely to rely on published documentation to guide

their EIA activities relative to experienced staff who would draw more on their own experience and be comfortable making their own judgments accordingly.

Particularly important is the preparation of substantive guidance to EIA. The perception of OEPA staff that Guidance Statements usefully condense knowledge for use in EIA is comparable with similar comments provided by environmental consultants in Western Australia previously (Waldeck et al., 2003). New substantive guidance is being developed by EPA as a consequence of a new internal policy derived from a multi-stakeholder review of the WA EIA process concluded in March 2009 (EPA, 2009b). The review identified a number of 'opportunities to deliver better environmental protection and to improve the efficiency and transparency' (EPA, 2009a, p. 7), including ways to streamline the scoping process, formalising timelines in EIA, and clearly specifying environmental outcomes to be met by proponents in conditions of approval issued by the Minister. Draft guidelines for these initiatives have since been published on the EPA website and represent new opportunities for organizational learning.

However, such improvements do not deal with a number of current shortcomings in terms of KM that have been identified in the course of this research. The treatment of cumulative impacts in EIA practice in WA is currently very limited, as the GIS only keeps information on the location of previous proposals, but does not include data generated by the respective environmental assessment. Thus, if an officer would like to retrieve information on an existing proposal in order to better understand the cumulative impacts, it would be necessary to review the files relative to that particular undertaking,

a time consuming task possibly incompatible with a project analysis timelines. These timelines are a significant constraint on project officers, as EPA is committed to deliver its recommendations in a relatively short period in order to respond to the constant criticism from proponents that the EIA process takes too long (EPA, 2009b; Middle and Middle, 2010).

The questionnaire findings also showed that OEPA has no clear policy or practice for the revision of older knowledge stocks. Outdated sources were mentioned several times by the respondents to the survey in the open discussion comments at the end of the questionnaire. To develop and review their EIA guidance, the OEPA will normally undertake several rounds of drafting and public review prior to their publication and thus the availability of human resources and timelines become constraints to the ability to quickly update knowledge repositories. Private organisations, in contrast, typically would not be faced with this issue. Specific resourcing of knowledge management activities may thus be an important element of an effective EIA practice.

6.2 Knowledge management initiatives

Although there has never been any formal knowledge management initiative in the OEPA, several actions have contributed to organizational learning. This characteristic has been identified by an Australian agency in charge of promoting good practices in the public service: ‘While many organizations may not use the term ‘knowledge management’ to describe their activities in this area, many relevant activities are

751 undertaken to enhance organizational learning, improve service delivery, and build
752 capabilities and flexibility.' (Agimo, 2004, p. 3).
753
754 Initiatives pertaining to both technology-based and human resources approaches to KM
755 have been implemented. The OEPA has been particularly active in producing guidance
756 and setting up different repositories, but 'well-defined KM strategies (…) going beyond
757 knowledge repositories' are used by the most advanced government organizations
758 (Riege and Lindsay, 2006, p. 25) were not identified in this survey, apart from the
759 mentoring program and the half-day introductory course (Section 5.3).
760
761 After-action reviews are not used as a learning mechanism for EIA. This activity is
762 defined as 'a facilitated discussion, conducted immediately after a project or major
763 activity and using a semi-structured format' that 'draws on the participants experience
764 and perceptions to help identify lessons' (Standards Australia, 2005). Fitzpatrick (2006,
765 p. 171) sees a post hoc analysis as a 'method for generating shared meaning' and
766 'debriefing and documenting lessons from specific experiences'. Interestingly, the
767 OEPA has identified after-action reviews as one means of improving EIA practice in
768 WA in their partnering agreement with the Environmental Consultants Association
769 (Morrison-Saunders and Bailey 2009) but these have not been employed to date.
770
771 In Canada, Fitzpatrick (2006, p. 168) mentioned the 'post hoc review' conducted by
772 government bodies after the assessment of two major projects as contributing to
773 enhancing the EIA processes in two jurisdictions. Findings led to 'improved
774 performance' (by modifying procedures for public information requests) and 'changed

theories in use' (or double-loop learning), in this case, pointing to reducing the number of issues debated in Canadian public hearings. In one case, a 'Lessons learned' document is available on the Internet.

One questionnaire respondent, working at OEPA for more than ten years, mentioned the need to update a report: 'written a long time ago which gathered all the relevant wisdom in EPA reports into a summary, making it easier to access'. This person was referring to EPA (1992), which, based on 'detailed research of the Authority's publications', selected fundamental 'principles' and lessons learned that could be useful for future assessments. This kind of after action review is also a further example of guidance material not being updated by OEPA.

As a relatively small agency with a unique function, OEPA is in itself a community of practice. Social networks do play a role in managing knowledge, notwithstanding the popularity of printed sources noted previously, as many questionnaire respondents stated they consult with people in the DEC or other government departments.

6.3 Beyond performing internal tasks

Despite achievements in KM, there are underexplored learning opportunities that could enhance EIA practice by the OEPA, the most prominent being that data and information gathered in the follow-up phase are not processed into meaningful knowledge for future assessments. Audit and compliance reports are filed with the Inspections and Compliance Branch (a DEC division) but then seemingly are forgotten. Consultants

who prepare such reports and the proponents can learn from them and potentially, such learning can be reflected in upcoming environmental assessment documents prepared by these consultants and proponents. However, there is no systematic or structured way of conveying learning to the OEPA or sharing such learning with other stakeholders.

The organization and its stakeholders are aware of the huge opportunities for improving knowledge management in the EIA process. Historically information generated in the assessment process has been used to inform and support OEPA decision-making, but only to a limited extent has it contributed to building a knowledge base. Through the establishment of the SEAK Taskforce (discussed in Section 5.3), there is an expectation that OEPA will find collaborative ways to build knowledge from the extensive ecosystem information that is gathered in the EIA process. Harnessing this knowledge would provide opportunities for double-loop learning (Argyris and Schön, 1996). At present information derived from project follow-up in EIA practice in WA is not properly captured and stored, thus not used to create new knowledge and to improve practice and effectiveness.

6.4 Going beyond conventional EIA practice

KM by EIA agencies is key to a broader learning process that potentially extends beyond immediate EIA stakeholders to influence environmental management activities that lie well beyond the scope of normal EIA practice. Our study has not attempted to measure such an influence but we believe that it is worthwhile flagging and it is an increasing feature of the EIA literature. For example the international effectiveness

study of Sadler (1996, p. 227) was one of the first explicit attempts to map out how EIA processes can be sharpened in order to become a 'tool for sustainability assurance'. One way to do this could be achieved through EIA follow-up where the combined efforts of project follow-up, EIA system review follow-up and meta-level evaluations of EIA efficacy as a concept (Arts and Morrison-Saunders, 2004, p. 312) contribute to 'environmental sustainability'.

Weaver et al (2008) emphasize the role of individual EIA practitioners in personally 'pushing the vectors' of sustainability. This sentiment is shared by Gibson et al (2005, p.188) who argue for a transition from project EIA to 'sustainability assessment' which ultimately is about 'making the world better, one undertaking at a time'. Another example comes from Downs (2008) who maps out how an enhanced EIA process could contribute to sustainable development and poverty eradication through 'an adaptive social learning process' and a 'trans-disciplinary, knowledge-partnership' approach amongst others. Similarly, Bond et al. (2010, p. 6) argue that ‘sustainability outcomes in EIA’ call for a ‘learning organization approach’, and Sheate and Partidario (2009, p. 287) call for ‘strategic approaches’ that facilitate the ‘exchange and transfer of knowledge already owned by stakeholders’.

Central to all of these thoughts – although not always acknowledged - is the key role of EIA agencies.

7. Conclusions

In this research we set out to identify and evaluate knowledge repositories established by the centralised EIA agency operating in Western Australia to understand their evolution and how they are used to improve ongoing EIA by the OEPA with a broader aim of deriving lessons that could be applicable to similar agencies in other jurisdictions.

The OEPA experience shows that even in the absence of a formal or systematic KM strategy, it is possible to adopt a number of initiatives conducive to manage an organization's ability to learn, store and use collective knowledge in support of its core activities. That a single agency has been responsible for EIA in WA for many years no doubt has contributed to success in KM whether through formal or informal means; i.e. an EIA system based around a single agency simply increases the opportunity for KM to occur. This is an important learning point for those jurisdictions designing or re-designing EIA systems and may have relevance for other environmental management agencies too.

The key elements of KM adopted by OEPA are: (i) the provision (to proponents, consultants and project officers alike) of substantive guidance on methods, approaches and assessment criteria; (ii) development of a GIS-supported spatial information database containing data on all proposals referred and significant environmental values nearby every new proposal.

The main opportunities for improvement lie in (i) ensuring that EIA guidance material is kept up-to-date; (ii) performing after-action reviews of selected assessments; (iii)

formalising a process for harnessing the extensive project performance and compliance data generated in follow-up to create new knowledge to guide future practice.

In terms of the main functions of KM (knowledge creation, retention, and transfer or share) OEPA appears to be particularly successful in retention and transfer to knowledge users. Less significant results are evident with respect to knowledge creation.

The OEPA case study clearly demonstrates that knowledge management initiatives can be useful for EIA agencies and are perceived to contribute to more effective EIA. We anticipate that equivalent enquiries conducted in other jurisdictions could identify other initiatives appropriate to such agencies and relevant to international practice.

The key elements of KM that are potentially relevant for other EIA agencies (and by extrapolation to other environmental management agencies more generally) are: (1) establishing and maintaining a comprehensive and easily accessible spatial information database; (2) preparation and periodic update, in consultation with major stakeholders, of substantive guidance on methods and criteria for EIA tailored to the context of each jurisdiction. An institutional arrangement to collect, filter and interpret information generated in the follow-up of projects submitted to the EIA process is a third element that potentially can enhance practice, but it remains untested in WA.

Ensuring environmental protection through EIA requires good management of the organizations in charge of administering the EIA process. Knowledge management is a key enabling process to accomplish this.

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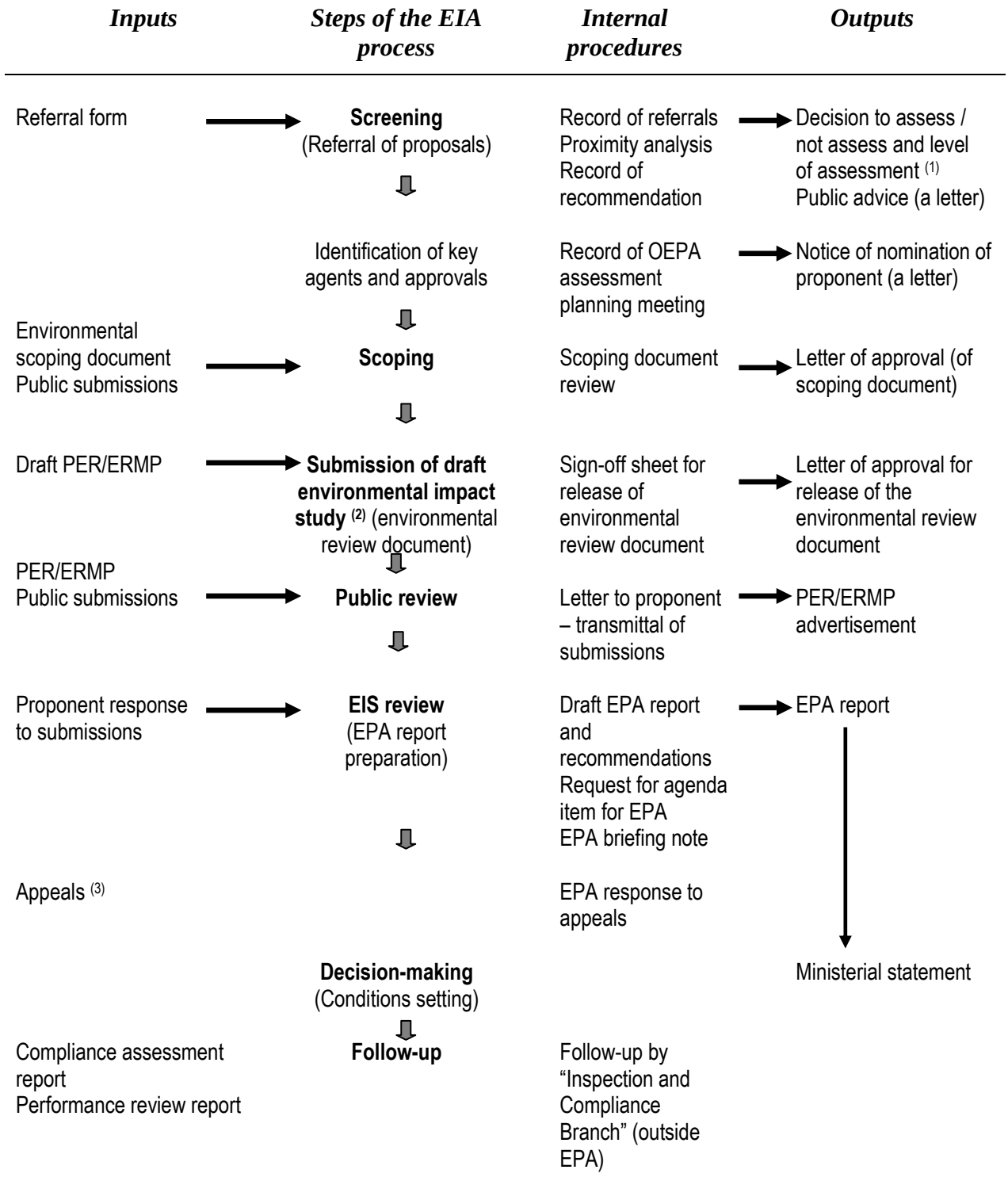
1033

1034

1035

[i] The concept of KM enablers is used here in accordance with Standards Australia (2005).
[ii] Quotations from an unpublished paper presented by Rob Sippe at the 16th Annual Meeting of the International Association for Impact Assessment, Estoril, Portugal, 1966.
[iii] Following a review of the EPA's policy framework carried out in 2008, new nomenclature and types of guidance documents have begun to be utilised. In this paper we refer to them generically as Guidance Documents.

Figure 1



Notes:
(1) EPA decides on the level of assessment, such as environmental protection statement (EPS), public environmental review (PER) and environmental review and management plan (ERMP), the latter corresponding to the highest and more detailed level of assessment
(2) WA legislation does not use the term "environmental impact study", which is employed here as a broad denomination for the sake of generalization; the term "environmental review document" encompasses the several types of studies under WA legislation
(3) the proponent and the public can appeal to an Appeals Convenor against any recommendation of EPA

Figure 2

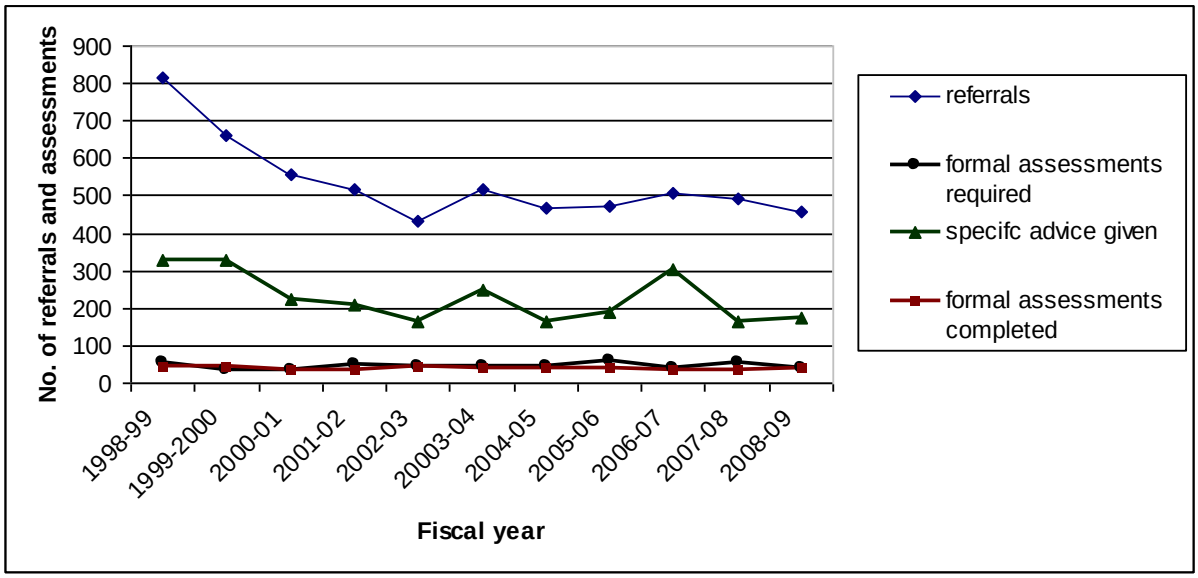


Figure 2: Annual variation of main documented inputs and outputs at OEPA. Source: EPA Annual Reports from 1998-1999 to 2008-2009.

Table 1
OEPA Internal Knowledge Repositories

	TYPE / NAME	AVAILABILITY		FORM OF ACCESS		
		INTERNAL USE ONLY	PUBLICLY AVAILABLE	INTRANET	FILES / PRINTED (1)	PERSONAL CONTACT
1	Geographical information system	■		■	■	■
2	Record of proposals referred and proximity analysis	■		■	■	
3	Officers Manual and templates	■		■		
4	Key environmental factors		■	■		
5	Guidelines for environmental review documents		■	■		
6	Environmental Protection Policies		■	■		
7	EPA Position Statements		■	■		
8	Guidance Statements		■	■		
9	EPA Reports (formerly bulletins)		■	■		
10	EPACIS - EPA Central Information System	■			■	
11	Files	■			■	
12	TRIM – Total Records Information System	■		■		
13	State of the Environment Report		■	■	■	
14	Staff meetings	■				■
15	Informal talks	■				■
16	Senior staff	■				■

Note: (1) Limited numbers of publicly available reports authored by the EPA are available (at no cost) in hard-copy, but all can be downloaded (pdf format) from the EPA website. Files are printed documents held within OEPA for internal use only.

sources: compiled from the EPA website (www.epa.wa.gov.au), internal documents and interviews.

Table 2 – OEPA knowledge repositories and their main features

	TYPE / NAME	DESCRIPTION
1	Geographical information system	contains several layers featuring "environmental values" (such as wetlands, threatened and priority ecological communities), zones covered by EPA environmental protection policies, position statements and guidance statements, public drinking water supply areas, a record of proposals referred to EPA and other spatial information; the EPA internal GIS started in 1994 and has been evolving since; an Intranet interface available to project officers is called GIS Viewer
2	Record of proposals referred and proximity analysis	every new proposal is received by GIS staff, its location and main features are entered into the system; a few proposals received prior to 2005 have been fed into the system; a project officer receives a "proximity analysis" document showing in a map or aerial photo the environmental values known at certain distances from the proposed site and all proposals previously referred to EPA
3	Officers Manual and templates	a compilation of internal procedures, templates and guidance; a first printed manual was released in 1991; currently it is composed of a series of electronic documents; templates are models of documents and letters relative to all aspects of the EIA process; several dozens templates are available in the Intranet
4	Key environmental factors	a comprehensive checklist of valued ecosystem components grouped under four categories (biophysical, pollution management and social surroundings); *critical environmental assets* is a term introduced in 2006 to describe factors of foremost importance, whereas *high value assets* designates other environmental assets that require a high level of protection
5	Guidelines for environmental review documents	guidance intended to proponents to assist the preparation of environmental impact documents (namely Public Environmental Review and Environmental Review and Management Programme); in performing the review task, project officers check the proponent's document against these generic guidelines and the environmental scoping document
6	Environmental Protection Policies	guidance to protect the environmental values of certain areas or that addresses State-wide issues; starting in 1992, nine such documents have been enacted as of December 7 2009
7	EPA Position Statements	"set EPA views on some matters of environmental importance" ;starting in 1999, there are nine Position Statements as of August 15 2009
8	Guidance Statements	"Guidance Statements are issued by EPA to assist proponents, and the public generally, to understand the minimum requirements for protection of elements of the environment that the EPA expects to be met during the assessment process"; 56 have been issued as of December 7 2009, but some are no longer in use and have been withdrawn
9	EPA Reports (formerly bulletins)	the main output of the review process; feature recommendations of the EPA; bulletins have been numbered since the beginning of EIA in the State, in 1974; 1345 reports released as of December 7 2009
10	EPACIS - EPA Central Information System	a database of assessments, including proponent details, decisions made and timelines, from referrals (screening) to determination of appeals on EPA Reports and issue of Ministerial Statement (approval and conditions)
11	Files	physical files containing all documents relative to every referral received by EPA; active files are maintained at the office for quick retrieval
12	TRIM – Total Records Information System	a system for electronic document management, storing documents, e-mails and scanned documents received by OEPA
13	State of the Environment Report	a first report was published in 1992; the most recent (2007) edition covers 34 "environmental issues" featuring a description of current conditions (with indicators), pressures, current and suggested responses; maps feature the spatial extent of each issue; each issue is ranked in a five-level priority score
14	Staff meetings	formal meetings to deal with ongoing assessments or referrals
15	Informal talks	by definition, any exchange of views or information between staff members; this category also include social networks both inside and outside the organization

16	Senior staff	some officers have more than 30 years of EIA experience; senior staff can play a significant role in sharing knowledge as they are officially designated as mentors for new staff

sources: compiled from the EPA website (www.epa.wa.gov.au), internal documents and interviews.

Table 3
Statements about internal knowledge repositories

statement	*disagree*	*agree*
A. Databases and knowledge sources at OEPA are easily accessible in terms of time and effort in retrieving information	7 (37%)	9 (50%)
B. Guidance Statements usefully condense EPA and DEC accumulated knowledge as applicable to EIA	2 (11%)	13 (72%)
C. Guidance Statements are not detailed enough to provide useful help	8 (42%)	6 (32%)
D. In my work, I have a preference for obtaining information from other people rather than from documents	61%	22%
E. I usually consult with people in other divisions of DEC	0	18 (100%)
F. I usually consult with people in other government departments	0	18 (100%)
G. I trust more the knowledge embedded in official sources than what I can directly obtain from people	7 (39%)	10 (56%)
H. The reports I prepare deal with such specific issues that I hardly ever find any useful knowledge in OEPA internal sources	13 (72%)	3 (17%)
I. The most accurate and reliable way of doing an internal task is to check how was it done last time	3 (17%)	14 (78%)

Note: results are presented in two broad groups; in the questionnaire, respondents were asked to mark “strongly disagree”, “partially disagree”, “unable to judge”, “partially agree”, and “strongly agree”; sums can be less than 100% where respondents indicated that they were “unable to judge”.

Table 4
Statements about internal knowledge creation

statement	*disagree*	*agree*
A. Working at OEPA provides meaningful opportunities to increase my personal knowledge		17 (100%)
B. Sharing information is part of my normal work activity		18 (100%)
C. At OEPA, mistakes are viewed as learning opportunities	2 (11%)	12 (67%)
D. In my work I generate new knowledge that can be used by OEPA in the future		14 (78%)
E. Significant parts of what I learn during my work is actually fed back into our future assessments	5 (28%)	12 (67%)
F. Preparation of well-informed EPA reports significantly contribute to decisions that protect the environment for present and future generations	3 (17%)	13 (72%)

Notes: (1) results are presented in two broad groups, as in Table 3; (2) one respondent did not rate statement A; for other sums smaller than 18, the balance is in the "unable to judge" category.